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BIOMASS RESOURCE ASSESSMENT AND POTENTIAL IN INDIA

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ABSTRACT

The present study has been taken to access biomass potential in India and its resource assessment. Biomass energy through hybridization can prove be a boon to India. Uttar Pradesh has generated highest cumulative biomass based gasifiers and cogeneration units. The rusk husk and sugarcane based agro residues undergo biomass gasification and more than 3000 MWe is estimated as biomass power potential in Uttar Pradesh only. States like Tamil Nadu, Maharashtra, Andhra Pradesh and Chhattisgarh have also developed more than 1500 MWe of biomass based power alone. The state of Jammu and Kashmir has best potential of biomass in forest residues and horticultural crops. Through innovative business models we can evolve a robust organised biomass market by motivating rural entrepreneurs to take up the responsibility of supplying biomass to processing facilities.

KEYWORDS: Biomass Potential, Cumulative Biomass & Biomass Market

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Original Article

INTRODUCTION

The rural areas are facing enormous electrical energy shortage and there are many areas in India where electricity is still a dream. The electricity shortage in these areas may be due to topography of area, distance from electric grid, population and other economic factors. More than 67 % of Indian population resides in rural areas and the dream of developed India is only possible through the development of rural areas. Biomass energy has been main energy source to mankind through the ages. In the current context, the major benefits include its renewable nature, wide availability, carbon neutrality and the potential to provide large productive employment in rural areas. Power generation potential of biomass, have recently been attracting greater attention. Ministry of New and Renewable Energy (MNRE), Government of India recognized the potential role of biomass power in the Indian economy quite early and since then has been the vanguard of its promotion. As a further outcome of the carefully planned mix of policy and financial incentives introduced by the Government, capacity has been built up in the country for absorption of biomass power technologies, their operation and maintenance, management of biomass collection, manufacturing of equipment and resolving grid interfacing issues. The availability of crop residues like bagasse, rice husk, coconut shells and the wood processing waste inherently limit the growth of the capacity of Biomass power generation **[1-3].** A place like Jammu and Kashmir which has major biomass available as forest residues and horticultural plantation can be an answer to growing power woes in state. One of the major barriers confronted by the Biomass power plants is a secured supply of required quality and quantity at a competitive price for sustainable operation of the plant. The current price of Biomass resources has slowly increased due to non-availability of feed stock at affordable price in recent years **[4].**

BIOMASS RESOURCES IN INDIA

In India over 500 million tons (MT) of Biomass is produced every year in different states like; Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Odisha, Punjab, Uttar Pradesh and West Bengal, [5].

State Wise Biomass Resources Availability

Out of total resources, 350 MT of agricultural based major biomass resources are contributed by bagasse, rice husk, straw, cotton, coconut stalk, coconut shells and groundnut shells. Uttar Pradesh is one of the states, which produces the highest quantity of major residue (56 MT) followed by Maharashtra (40 MT) and Punjab (37 MT) [6] as shown in figure 1. The major agricultural based biomass crop wise potential for different states of India are presented in figure 2. Uttar Pradesh has the highest potential of crop residue in sugarcane, rice husk, wheat straw and pearls millet.

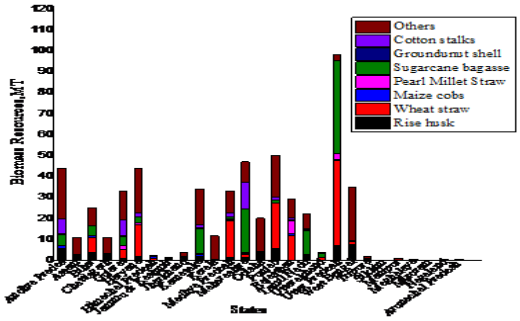
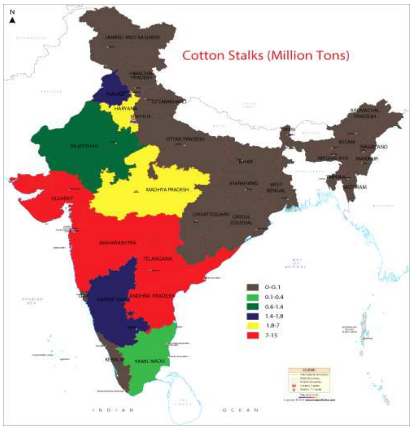
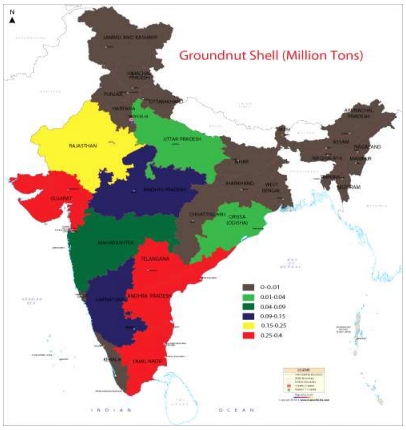


Figure.1: State Wise Agricultural Based Biomass Residues





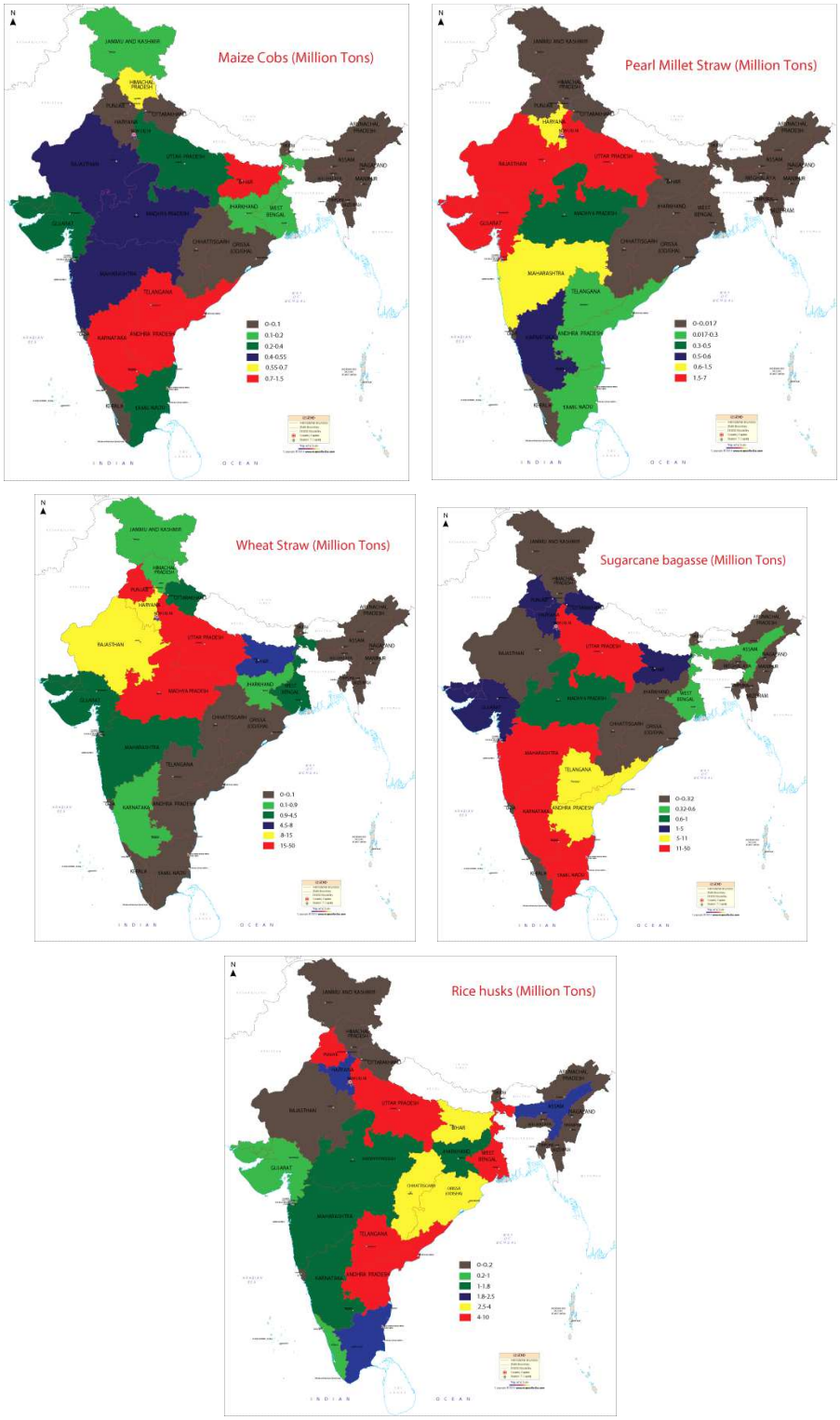


Figure.2: State Wise Biomass Crop Potential in India

Biomass Energy Potential

The assessment of scale up potential has been carried out separately for crop residues and energy plantations. The assessment in the case of crop residues basically focused on the market for utilization of residues such as stalk and straw for power generation during the 12th Five Year Plan. The biomass energy potential Estimates from residue surplus

has used the following equation and are given in figure-3 [7];

$$E(j)=\sum_{i=1}^{n} CRs(i,j)\times H.V(i,j) \tag{1}$$

Where, $E(j)$ is biomass energy potential of 'n' crops at j^{th} state (MJ), $CRs(i,j)$ is surplus residue potential of i^{th} crop at j^{th} state (kg) and $H.V(i,j)$ is heat value of i^{th} crop at j^{th} state, MJ/kg, as given table-1.

The Surplus residue potential of i^{th} crop at j^{th} state are as per following equation;

$$CRs(j)=\sum_{i=1}^{n} CRg(i,j)\times SF(i,j) \tag{2}$$

Where, $CRs(j)$ is the residue surplus at j^{th} states, $CRg(i,j)$ is the potential of residue on i^{th} crop at j^{th} states $(tonne)$ and $SF(i,j)$ is the residue fraction of i^{th} crop at j^{th} states [8].

The state wise biomass energy potential from major seven surplus residue is maximum in Uttar Pradesh (1044 PJ). The other major surplus residue states are Punjab (434.75), Maharashtra (258.82), Haryana (198.50), Madhya Pradesh (180.75), Gujarat (159), Karnataka (157.9), Tamil Nadu (155.75), Rajasthan (151.30) and Andhra Pradesh (121.73).

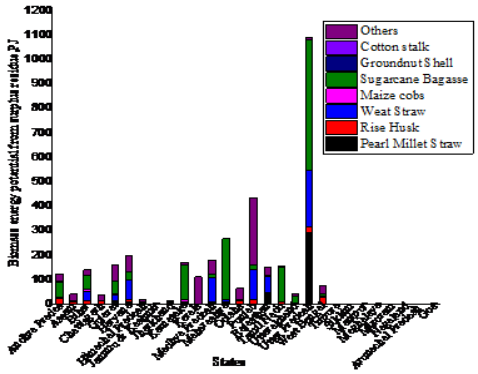


Figure 3: State Wise Biomass Power Energy Potential from Surplus Residue

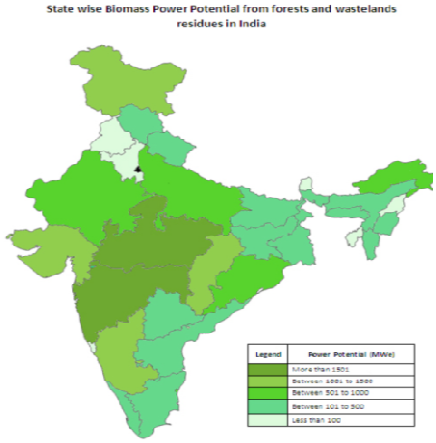


Figure 4: State Wise Biomass Power Potential Forests and Wastelands in India

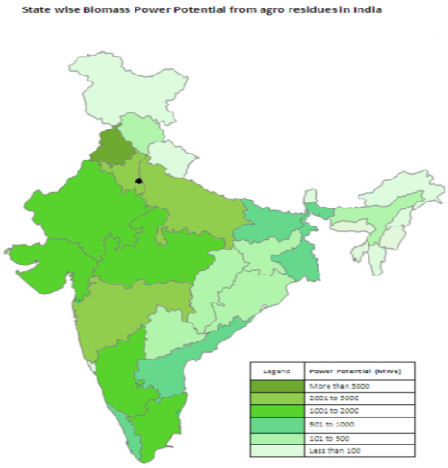


Figure 5: State Wise Potential from Agro Residues in India

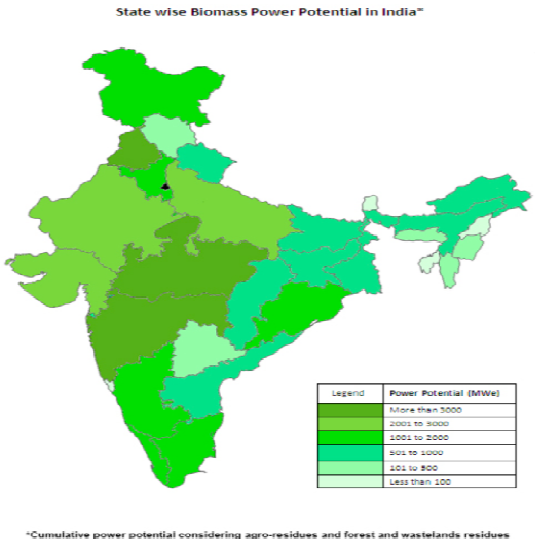


Figure 6: State Wise Biomass Power Potential in India

The heating values of various biomass species and others materials are given **table.1** along with proximate

analysis results.

Crop	Types of Residue	Heating Value(MJ /kg)	References
Rice	Straw	15.54	9
	Husk	15.54	10
Wheat	Stalk	17.15	10
Coarse Cereal	Straw and husk	18.16	11
Sugarcane	Bagasse	20	10
	Tops	20	10
	Trash	20	10
Coconut	Shell	10	12
	Fibre	19.4	13
	Pith	19.4	13
Cotton	Stalks	17.4	14
	Gin Waste	16.7	15
Oilseeds	Straws and husks	14.35	16
Pulse	Straw	14.65	17
Jute/ Mesta	Stalks	19.7	18

Present Status of Biomass Power Plant Available In India

As per 12thfive year plan, the proposed power generation installation capacity is 1000 MW. The state wise target for the 12thfive year plan and the installed capacity till 31.3.2012 are shown in figure 7.

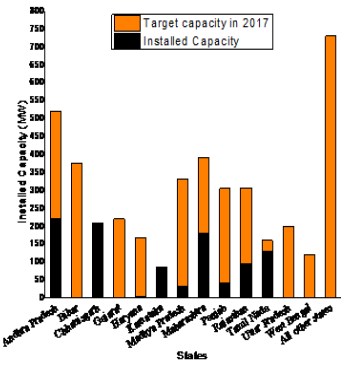


Figure 7: Target Installation Capacity of Biomass Power Plant

The targeted power generation potential for 13th plan is estimated as 5730 MW [19]. Biomass based power generation capacity of 10 GW by the year of 2022 has been predicted for India [20]. A grid connected biomass gasifier based project of 1 MW capacity in Haryana has been installed for meeting the captive power needs of the industry. Another 50 numbers of Biomass gasifier systems and combustion based power projects with cumulative installed capacity of 8.54 MW are under installation which shall meet the captive demand for electricity & thermal energy [21]. World's largest coconut tree waste based power plant has been installed in Coimbatore district of Tamil Nadu. The generation capacity of this plant is 10 MW, which produces 75 million units of electricity annually [22].

Programme/scheme wise physical progress	
Sector	**Achievements (capacity in MW) (as on 31.03.2016)**
I. Grid Interactive Power (Capacities in MW)	
Biomass Power (Combustion, Gasification and Bagasse Cogeneration)	**4,831.33**
Waste to Power	115.08
Sub-total Grid Interactive	**4,946.41**
II. Off-Grid / Captive Power (Capacities in MWe)	
Biomass (non bagasse) Cogeneration	651.91
Biomass Gasifiers	
Rural Industrial	18.15
	164.24
Waste to Energy	160.16
Sub-total Off-Grid	994.46
Total Biomass Based Power	**5940.87**

If biomass is grown sustainably, its production and use leads to no net building of carbon dioxide (CO_2) in the atmosphere because the CO_2 released in combustion is offset by the CO_2 extracted from the atmosphere during photosynthesis.

The use of biomass for power generation can address the issue of growing energy needs in rural areas. The high energy costs and irregular energy generation has popularized biomass based power generation. To meet such large energy demand, various thermos-chemical conversion technologies are encouraged and studied in detail. Heat and power, which is must for industrial growth uses direct combustion technologies using steam route. An extension of this technology to improve the efficiency has been co-generation which has gained importance in agriculture, cement, paper and sugar industries. wherever the biomass availability is assuredto meet the heat and power demand, biomass based power generation must be encouraged than other sources of energy. At large power levels, it has been found that biomass sourcing would play a critical role in plant economics.

In order to mitigate energy crisis in country, biomass energy should be prioritized to the same extent as solar or wind energy and same incentives and tariffs must be given to biomass energy as that of solar/wind or alternate hydro energy.. Moreover, for a long time this nationally important resource is languishing in terms of R&D and innovation.

Overview of Biomass Power Sector in India

Biomass has always been an important energy source for the country considering the benefits and promises it offers. It is a carbon neutral fuel source for the generation of electricity; and apart from providing the much-needed relief from power shortages, biomass power projects could generate employment in rural areas.

The Ministry of New and Renewable Energy (MNRE), Government of India has realized the potential and role of biomass energy in the Indian context and has initiated a number of programmes for the promoting biomass conversion for power generation and other applications The State wise cumulative achievement of biomass power and cogeneration projects is as follows:

State Wise Biomass Power and Cogeneration Projects	
State	**Capacity (MW)**
Andhra Pradesh*	389.75
Bihar	43.42
Chhattisgarh	264.90
Gujarat	55.90
Haryana	52.30
Karnataka	737.28
Madhya Pradesh	36.00
Maharashtra	1,112.78
Odisha	20.00
Punjab	140.50
Rajasthan	111.30
Tamil Nadu	662.30
Uttarakhand	30.00
Uttar Pradesh	936.70
West Bengal	26.00
Total	**4,761.00**

*Capacity includes projects of both Andhra Pradesh and Telangana
Source: MNRE Annual Report 2015-16

According to the Biomass Resource Atlas (2002-04) prepared by the Indian Institute of Science, Bangalore, more than 300 districts in India have biomass potential between 10-100 MW. Considering the present status of biomass based power generation and thermal applications, it is expected that only about 30-35 million tonnes of surplus biomass is being used annually for the existing and ongoing biomass projects.

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